Package ‘RIFS’

February 19, 2015

Type Package
Version 0.1-5
Date 2012-06-04
Title Random Iterated Function System (RIFS)
Author Pavel V. Moskalev, Alexey G. Bukhovets and Tatyana Ya. Biruchinskay
Maintainer Pavel V. Moskalev <moskaleff@gmail.com>
Description RIFS package provides functionality for generating & plotting prefractals in R^n with various protofractal sets and partition coefficient for iterative segments
Depends R (>= 2.14.0)
License GPL-3
LazyLoad yes
URL http://www.r-project.org
Repository CRAN
Date/Publication 2012-06-05 05:58:58
NeedsCompilation no

R topics documented:

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RIFS-package

Random Iterated Function System (RIFS)

Description

RIFS package provides functionality for generating & plotting prefractal sets in $\mathbb{R}^n$ with various protofractal sets, probability distribution, and partition coefficient for iterative segments.

Details

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`plotR2pre()` function draws a prefractal set in $\mathbb{R}^2$.

`preRIFS()` function generates a sample of fractal points (a prefractal points) in $\mathbb{R}^n$ with a random iterated function system (RIFS).

`preRSum0()` function generates a sample of fractal points (a prefractal points) in $\mathbb{R}^n$ with a matrix of random sums of a numerical series.

`R2ngon()` function generates a regular polygonal set in $\mathbb{R}^2$.

Author(s)

Pavel V. Moskalev, Alexey G. Bukhovets and Tatyana Ya. Biruchinskay

plotR2pre

Plot a prefractal set in $\mathbb{R}^2$

Description

plotR2pre() function draws a prefractal set in $\mathbb{R}^2$.

Usage

```r
plotR2pre(l=preRIFS(),
          s="Prefractal points for 3-gon: k=3; p=1/3; mu=1")
```
Arguments

- l: a list with prefractal ($pre$) and protofractal ($proto$) points & indexes ($index$).
- s: a string for the main title.

Details

A regular polygon is a convex polygon in which all edges and all angles are equal.

A protofractal set $Z$ is a discrete or continuous set, which in the iterative process generates a sample of the fractal set (a prefractal set) $X$.

Author(s)

Pavel V. Moskalev and Alexey G. Bukhovets

See Also

- preRIFS

Examples

```r
# Example 1. Sierpinski triangle, 1st order, p=const, mu=var
for (m in seq(-4, 0)) {
  plotR2pre(preRIFS(M=2^rnorm(n=3, mean=m, sd=-m/4)),
            s="Prefractal points for 1st order 3-gon")
  Sys.sleep(0.5)
}

# Example 2. Uniform distribution, 1st order, p=const, mu=var
for (m in seq(-4, 0)) {
  plotR2pre(preRIFS(Z=R2ngon(4,1),
                   M=2^rnorm(n=4, mean=m, sd=-m/4)),
            s="Prefractal points for 1st order 4-gon")
  Sys.sleep(0.5)
}

# Example 3. Sierpinski triangle, 2nd order, p=const, mu=var
for (m in seq(-3, 1)) {
  plotR2pre(preRIFS(Z=R2ngon(3,2),
                   M=2^rnorm(n=8, mean=m, sd=-m/4)),
            s="Prefractal points for 2nd order 3-gon")
  Sys.sleep(0.5)
}

# Example 4. Sierpinski square, 2nd order, p=const, mu=var
for (m in seq(-3, 1)) {
  plotR2pre(preRIFS(Z=R2ngon(4,2),
                   M=2^rnorm(n=8, mean=m, sd=-m/4)),
            s="Prefractal points for 2nd order 4-gon")
  Sys.sleep(0.5)
}
```
**Prefractal points in R^n generated with a RIFS**

**Description**

The `preRIFS()` function generates a sample of fractal (prefractal) points in R^n with a random iterated function system (RIFS).

**Usage**

```r
preRIFS(n=10000, Z=R2ngon(),
        P=rep(1/nrow(Z), times=nrow(Z)),
        M=rep(1, times=nrow(Z)))
```

**Arguments**

- `n` a number of prefractal points.
- `Z` a set of protofractal points.
- `P` a probability distribution of protofractal points.
- `M` a partition coefficients distribution of protofractal points.

**Details**

A protofractal set Z is a discrete or continuous set, which in the iterative process generates a prefractal set X.

A prefractal set X is a sample of an attractor (fractal) of a random iterated function system:

\[ X[i] \leftarrow (X[i-1] + M[z[i]]*Z[z[i]])/(1 + M[z[i]]) \]

where the index i in `seq(n)`; the index z corresponds to a random points sample of a protofractal set Z.

**Value**

A list with the prefractal (`$pre`) and protofractal points (`$proto`); distributions of probabilities & coefficients (`$distr`); sample of protofractal indexes (`$index`).

**Author(s)**

Pavel V. Moskalev and Alexey G. Bukhovets

**References**


**See Also**

`R2ngon`, `plotR2pre`, `preRSum0`
Examples

# Example 1a. Sierpinski triangle, 1st order, p=const, mu=const
l <- preRIFS()
pr <- rainbow(n=nrow(l$proto), v=0.9)
plot(l$proto, asp=1, col=r,
     main="Prefractal points for 3-gon: k=3; p=1/3; mu=1")
points(l$pre, pch=46, col=r[l$index])

# Example 1b. Sierpinski triangle, 1st order, p=var, mu=const
l <- preRIFS(p=c(2,2,5)/9)
pr <- rainbow(n=nrow(l$proto), v=0.9)
plot(l$proto, asp=1, col=r,
     main="Prefractal points for 3-gon: k=3; p=(2,2,5)/9; mu=1")
points(l$pre, pch=46, col=r[l$index])

# Example 1c. Sierpinski triangle, 1st order, p=const, mu=var
l <- preRIFS(M=c(4,4,6)/5)
pr <- rainbow(n=nrow(l$proto), v=0.9)
plot(l$proto, asp=1, col=r,
     main="Prefractal points for 3-gon: k=3; p=1/3; mu=(4,4,6)/5")
points(l$pre, pch=46, col=r[l$index])

# Example 2a. Sierpinski square, 2nd order, p=const, mu=const
l <- preRIFS(Z=R2ngon(4,2), M=rep(2,8))
pr <- rainbow(n=nrow(l$proto), v=0.9)
plot(l$proto, asp=1, col=r,
     main="Prefractal points for 4-gon: k=8, p=1/8, mu=2")
points(l$pre, pch=46, col=r[l$index])

# Example 2b. Sierpinski square, 2nd order, p=var, mu=const
l <- preRIFS(Z=R2ngon(4,2), P=2*abs(seq(-3,4))/45, M=rep(2,8))
pr <- rainbow(n=nrow(l$proto), v=0.9)
plot(l$proto, col=r, asp=1,
     main="Prefractal points for 4-gon: k=8, p=2*[-3:4]/45, mu=2")
points(l$pre, pch=46, col=r[l$index])

# Example 2c. Sierpinski square, 2nd order, p=const, mu=var
l <- preRIFS(Z=R2ngon(4,2), M=1.2*abs(seq(-3,4))+0.5)
pr <- rainbow(n=nrow(l$proto), v=0.9)
plot(l$proto, col=r, asp=1,
     main="Prefractal points for 4-gon: k=8, p=1/8, mu=0.5+1.2*[-3:4]")
points(l$pre, pch=46, col=r[l$index])

---

**prerSum0**

 Prefractal points in $\mathbb{R}^n$ generated with a matrix of random sums

Description

`preRSum0()` function generates a sample of fractal (prefractal) points in $\mathbb{R}^n$ with a matrix of random sums of a numerical series.
Usage

preRSum0(n=10000, mu=1, eps=1e-9, Z=R2ngon(),
P=rep(1/nrow(Z), times=nrow(Z)))

Arguments

n     a number of prefractal points.
mu    a partition coefficient for iterative segments.
eps   an error of a random sum of a numerical series.
Z     a set of protofractal points.
P     a probability distribution of protofractal points.

Details

A protofractal set \( Z \) is a discrete or continuous set, which in the iterative process generates a prefractal set \( X \).

A prefractal set \( S \) is a sample of a fractal set generated with a matrix of random sums \( S \) of a numerical series:

\[
S[i,j] \leftarrow \text{sum}(X[i==j]),
\]

where \( i \) in seq(n); \( j \) in seq(k); \( k \) <- nrow(Z); \( X \) <- \( \text{mu}/(\text{mu}+1)^\text{seq(m)}; \)
\( m \) <- 1-\( \text{log(eps*mu)/log(1+mu)}; \)
\( l \) <- sample.int(k, size=m, prob=P, replace=TRUE).

Value

A list with the prefractal ($pre$) and protofractal points ($proto$); distributions of probabilities & coefficients ($distr$).

Author(s)

Pavel V. Moskalev, Alexey G. Bukhovets and Tatyana Ya. Biruchinskay

References


See Also

R2ngon, preRIFS, plotR2pre
**Examples**

```r
# Example 1a. Sierpinski triangle, 1st order, p=const, mu=const
1 <- preRSum()  # generates a regular polygonal protofractal set in R^2
plot(l$proto, asp=1, col="red",
     main="Prefractal points for 3-gon: k=3; p=1/3; mu=1")
points(l$pre, pch=6, col="red")

# Example 1b. Sierpinski triangle, 1st order, p=var, mu=const
1 <- preRSum(P=c(2,2,5)/9)  # generates a regular polygonal protofractal set in R^2
plot(l$proto, asp=1, col="red",
     main="Prefractal points for 3-gon: k=3; p=(2,2,5)/9; mu=1")
points(l$pre, pch=6, col="red")

# Example 2a. Sierpinski square, 2nd order, p=const, mu=const
1 <- preRSum(Z=R2ngon(4,2), mu=2)  # generates a regular polygonal protofractal set in R^2
plot(l$proto, asp=1, col="red",
     main="Prefractal points for 4-gon: k=8, p=1/8, mu=2")
points(l$pre, pch=6, col="red")

# Example 2b. Sierpinski square, 2nd order, p=var, mu=const
1 <- preRSum(Z=R2ngon(4,2), P=2^abs(seq(-3,4))/45, mu=2)  # generates a regular polygonal protofractal set in R^2
plot(l$proto, asp=1, col="red",
     main="Prefractal points for 4-gon: k=8, p=2^|3:4|/45, mu=2")
points(l$pre, pch=6, col="red")
```

**Description**

R2ngon() function generates a regular polygonal protofractal set in $R^2$.

**Usage**

R2ngon(n1=3, n2=1, r=1, o=c(0,0), cycle=FALSE)

**Arguments**

- **n1**: a number of vertices of a regular polygon.
- **n2**: a number of partition points for the edges of a regular polygon.
- **r**: a radius of the circumscribed circle.
- **o**: a center of the circumscribed circle.
- **cycle**: logical; if cycle=FALSE, first & last points are not equal.

**Details**

A regular polygon is a convex polygon in which all edges and all angles are equal. A protofractal set $Z$ is a discrete or continuous set, which in the iterative process generates a sample $X$ of a fractal set.
Value

A matrix of points coordinates of a protofractal set in $\mathbb{R}^2$.

Author(s)

Pavel V. Moskalev

See Also

preRIFS

Examples

```r
plot(R2ngon(n=90, cycle=TRUE), type="l", asp=1, col="gray",
     main="Regular \{3,4,5,7,11\}-gonal sets in $\mathbb{R}^2$"
for (n in c(3,4,5,7,11))
  lines(R2ngon(n=n, cycle=TRUE),
     type="b", pch=16, col=hsv(h=(n-2)/9,v=0.9))
```
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